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CAPSTANS FOR ADVANCING STRANDS

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2 Sheets-Sheet 1

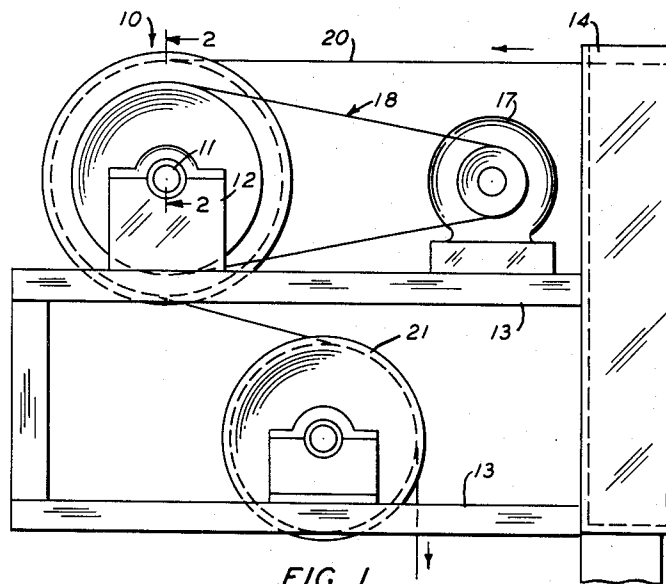


FIG. 1

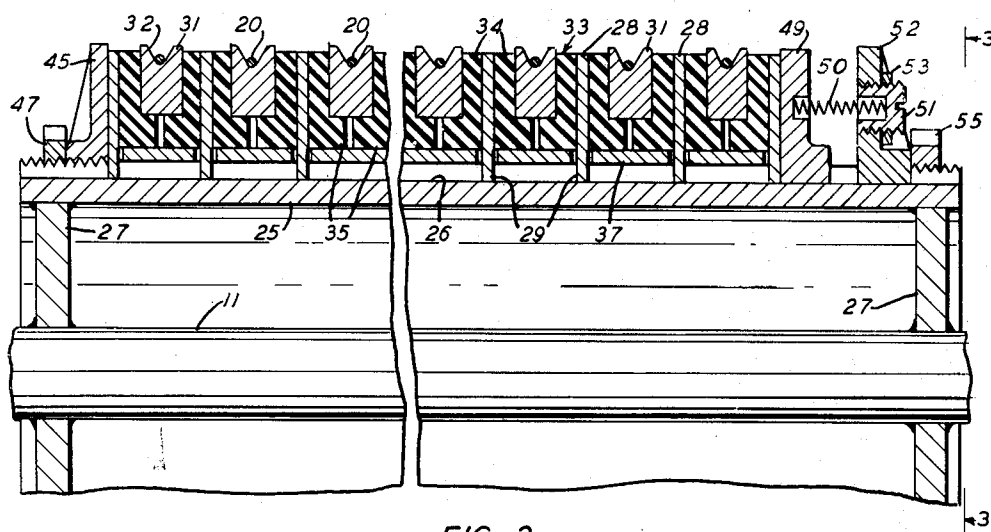


FIG. 2

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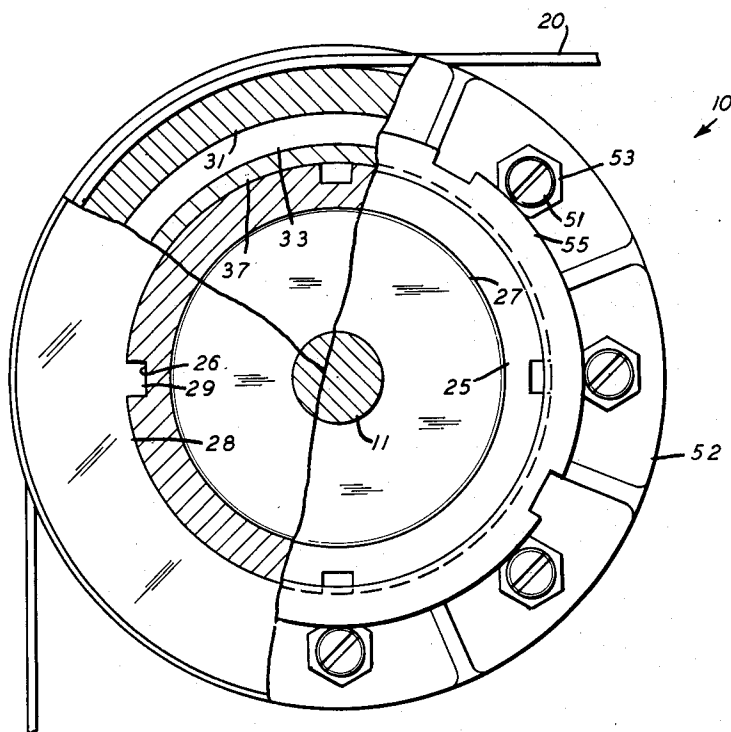


FIG. 3

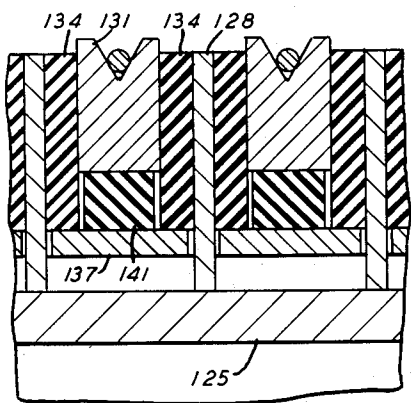


FIG. 4

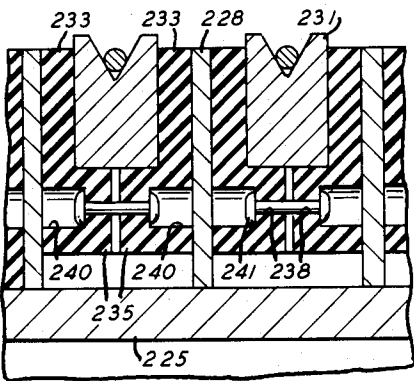


FIG. 5

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CAPSTANS FOR ADVANCING STRANDS

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5 Claims. (Cl. 191—1)

This invention relates to capstans for advancing strands, and more particularly to a composite capstan having a plurality of annular wire supporting elements mounted thereon in relatively movable relationship for advancing a plurality of wires through a plating bath.

It is an object of the invention to provide a composite capstan having a plurality of yieldably mounted wire supporting elements for advancing a plurality of strands in insulated relation to each other.

One type of capstan illustrating certain features of the invention may be provided with a rotatable member, a plurality of strand-engaging sections mounted on the rotatable member, a plurality of discs mounted on the rotatable member between the sections and means for urging the sections and the discs together to create frictional engagement therebetween.

In accordance with one specific embodiment of the invention there is provided a capstan for advancing a plurality of wires through a plating bath, and a drum mounted on the shaft for rotation therewith and having a plurality of splines therein for receiving a plurality of metal friction driving discs splined thereon in spaced relation to each other for rotation with the drum and for axial movement relative thereto. Encircling the drum between adjacent driving discs are metal rings having grooves for receiving and supporting the wires therein and supported in spaced relation to the discs and the drum by annular insulating spacers. The series of annular driving discs, metal rings, and insulating spacers are compressed against each other between a stop on one end of the drum and a movable pressure ring pressed toward these elements by a plurality of compression springs supported on the opposite end of the drum.

Other objects and advantages of the invention will become apparent by reference to the following detailed description of specific embodiments thereof and the accompanying drawings illustrating several embodiments of the invention, in which:

Fig. 1 is a fragmentary side elevational view of the capstan applied to a plating tank for withdrawing a plurality of wires from the tank;

Fig. 2 is a fragmentary vertical section taken along line 2—2 of Fig. 1;

Fig. 3 is a vertical section taken along line 3—3 of Fig. 2 with parts broken away;

Fig. 4 is a fragmentary section showing another embodiment of the invention, and

Fig. 5 is a view similar to Fig. 4 showing still another embodiment of the invention.

Referring to the drawings, a capstan 10 is fixed to a shaft 11 which is rotatably supported at its ends in bearings 12 mounted on a suitable framework 13 at one end of a plating tank 14. A motor 17 connected to the shaft 11 through a pulley and belt driving connection 18 serves to rotate the capstan 10 and cause it to withdraw a plurality of wires 20 from the plating tank 14 and advance them over a plurality of idler pulleys 21 to take-up reels (not shown) at a lower level, as indicated in Fig. 1.

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The capstan 10 comprises a cylindrical metal drum 25 having a plurality of axially extending keyways 26. The drum 25 is secured at its ends to a pair of heads 27, which in turn are secured to the shaft 11. A plurality of annular metal driving discs 28 are slidably mounted on the drum 25 and have key-like projections 29 extending into the keyways 26 for fixing the discs on the drum for rotation therewith. Between adjacent ones of the discs 28 are disposed annular metal rings 31 having generally V-shaped grooves 32 on the outer peripheries thereof for receiving the wires 20 therein. The metal rings 31 have flat, opposite, side faces and a circular inner periphery, and are adapted to be supported on the drum 25 in spaced and insulated relation to the drum and the annular discs 28 by suitable spacer means.

The preferred embodiment of the spacer means comprises annular insulating spacers 33 (Fig. 2) of L-shaped cross-section having flat disc portions 34 and axially extending cylindrical flanges 35. The spacer members 33 are arranged in pairs on opposite sides of the rings 31, with the disc portions 34 positioned between rings 31 and the discs 28 and the flanges 35 directed toward each other in engagement with the inner periphery of the metal rings 31. The spacer members 33 are supported on bushings 37 encircling the drum 25. The spacers 33 are proportioned to provide space between the adjacent end faces of the cylindrical flanges 35 to permit a slight movement of the members toward each other, and the bushings 37 are of such a width as to permit a slight axial movement of the metal discs 28 relative to each other.

The grooved rings 31 preferably fit tightly on the axially extending flanges 35 of the L-shaped insulating spacers 33, and each of the bushings 37 preferably fits tightly in the associated pair of spacers 33. The bushings 37 have a free receiving fit on the drum 25 for free rotatable engagement therewith. With this construction, each grooved ring 31 together with its associated pair of spacers 33 and bushing 37 forms a unit, slidably and rotatably engaging the drum 25.

The series of metal drive discs 28, grooved metal rings 31, and the spacers 33 are adapted to be forced together axially to grip the grooved rings 31 to form units for rotation with the drum, the pressure being adjusted to permit slipping of the individual units in the event a pulling force exceeding a predetermined value is offered by one or more of the wires being advanced. The spacers 33 are pressed against the discs 28 so that all rotational yield of the grooved rings relative to the drum takes place by virtue of slip between the spacers 33 and the driving discs 28. The bushings 37 act as bearings for the units to revolve freely on the drum 25 except for the frictional restraint offered by the discs 28.

The pressure applied to the several members is effected by an annular flange 45, which is threadedly mounted on the threaded end portion of the drum 25 and is locked in adjusted position by a lock nut 47. The flange 45 serves as a stop against which the series of annular members 28, 31 and 33 are pressed together. An annular pressure flange 49 is keyed to the drum 25 for rotation therewith and with free axial movement thereon. The flange 49 is designed to engage the other end of the series of annular members and is urged toward the flange 45 by a plurality of compression springs 50 arranged in a circle. The springs 50 are seated at one end in recesses in the flange 49 and at the other end in threaded retainers 51, which are adjustably mounted in a flange 52 and locked in adjusted position by lock nuts 53. The flange 52 is keyed to the drum for rotation therewith and is locked in position by a lock nut 55.

By adjusting the position of the flange 45 axially on the drum and by adjusting the retainers 51 the pressure of the springs 50 may be adjusted to exert a predetermined

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pressure against the flange 49 to cause the series of rings 31, spacers 33, and driving discs 28 to be forced against each other between the members 45 and 49 with sufficient pressure to drive the rings 31 with a predetermined torque, the value of which is such that the individual rings 31 may slip relative to the drum in response to a predetermined resistance offered by the individual wires to the movement of the rings associated therewith.

It should be noted that the total torque applied by the driven drum 25 must be at least sufficient to pull all the wires at a predetermined tension, but that, no matter how many less wires than the full complement are running over the capstan, no wire will at any time be subjected to more than the predetermined pull because of the slipping provision on the individual wire groove members. The pressure establishing means acting on the stack of rings together assures that all wires will be subjected to substantially the same pull.

While each of the rings 31 and its associated spacers 33 and bushings 37 are joined with press fits and together normally form a unit that turns as one assembly, there may be cases where the circumstances are such that these elements turn individually. Thus, if for instance for some reason the friction between one set of spacers 33 and the adjacent discs 28 should become so great that no slippage would occur between them, and the pull on the wire passing over that particular ring should become great enough, the ring would turn relative to its supporting spacers. This provides a safety factor which might prevent breakage of the wire or of the components of the capstan.

In the modified form of construction shown in Fig. 4, a pair of annular, insulating spacer discs 134 is disposed between metal discs 128, and grooved metal rings 131. Insulating rings 141 engageable with the inner periphery of the rings 131 encircle bushings 137 to support the rings 131 in concentric relation with a drum 125. The grooved metal rings 131 preferably fit tightly on the bushings 137, and the spacer discs 134 likewise fit tightly on the ends of the bushings. As in the previous embodiment, the bushings 137 have a free fit on the drum 125 for free rotatable engagement therewith.

This construction is such that each ring 131 with its associated discs 134, ring 131 and bushing 137 forms a unit rotatably mounted on the drum 125. Here again the frictional engagement is between the metal discs 128 and the insulating discs 134, and the coefficient of friction between those elements will determine the slippage therebetween for a given pull.

Another modification of the invention is shown in Fig. 5. In this modification there are provided a plurality of grooved metal rings 231, which are supported by L-shaped insulating spacers 233, which resemble those shown in Fig. 2. However, the flange portion 235 on each spacer is provided with a bore 238 and a counterbore 240. A tubular rivet 241 is inserted in the bores 238, and is pressed in position to cause each pair of spacers 233 to engage their associated ring 231 tightly so as to form a unit therewith. In this embodiment of the invention, the spacers 233 have internal bores which just encircle a drum 225 to have a running fit therewith, and no bushings are inserted between the spacers and the drum. Driving discs 228, which are identical with the previously described discs 28, are positioned between the units composed of the rings and spacers in the manner previously described.

The spacers 33, the discs 134, the rings 141 and the spacers 233 may be moulded, punched, cut, or otherwise formed from suitable electrical insulating material, such as phenol canvas. They also may be made of hard rubber or other suitable insulating material, if desired. The metal driving discs 28, 128 and 228 preferably are made of hardened and ground steel. The coating surfaces of the driving discs and the spacers, or spacer discs, are

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machined or ground so that they will be perfectly parallel when in engagement with each other to provide effective frictional drives between these elements.

The rings 31 are made of a metal that is wear resistant, has a high coefficient of friction, and also is a good conductor of electricity. For example, they may be made of a tough, abrasion resistant nickel-chromium steel, manganese steel, or the like. Whenever any of these rings becomes worn, the capstan may be disassembled and the worm rings replaced by new ones. Thus, it is not necessary to replace the entire capstan when only a part of the total wire-engaging surface thereof becomes worn.

The spacers 33, discs 134, rings 141, spacers 233, and driving discs 28, 128 and 228 may be replaced, when damaged or worn, without difficulty by disassembling the capstan and reassembling it with whatever new elements are required. The remaining elements of the capstan may be continued in use, if desired.

In some instances it may not be necessary to have the wire supporting rings electrically insulated from each other. In such case the spacers, such as the spacers 33, may be made of bearing bronze, babbitt, cast iron, or metallized graphite. All of these materials will provide friction elements, but they are not electrical insulators. Obviously, the compositions of the elements in frictional engagement with each other will be such as to provide the coefficient of friction therebetween which is required for a particular set of operating conditions.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A capstan for advancing a plurality of wires comprising a rotatable cylindrical member having a plurality of axial splines therein, a plurality of annular driving discs splined on said cylindrical member for rotation therewith and for axial movement relative thereto, cylindrical bushings mounted on said rotatable cylindrical member between adjacent driving discs, a plurality of metal rings having strand-engaging outer peripheries and flat end faces and being disposed between adjacent driving discs, means comprising a plurality of annular members of insulating material having portions thereof disposed between and engageable with said ring and said driving discs and having portions thereof engageable with the inner periphery of said rings and with said bushings for supporting said rings in concentric relation to said cylindrical member, and means on said cylindrical member for compressing said driving discs, said annular insulating members, and said rings against each other to establish a friction driving connection between said rings and said rotatable cylindrical member.

2. A capstan for advancing a plurality of strands comprising a rotatable cylindrical member, a plurality of annular metal driving discs mounted on said cylindrical member for rotation therewith and for axial movement relative thereto, a plurality of metal rings having strand supporting outer peripheries and flat end faces, said rings being disposed between said driving discs, insulating means for supporting said rings in insulated and spaced relation to said cylindrical member and said driving discs, said insulating means including annular members of L-shaped cross-section having flat portions interposed between and engageable with the end faces of said rings and the adjacent driving discs and having facing cylindrical flanges engageable with the inner periphery of said rings for supporting said rings on said cylindrical member in concentric relation thereto, and means positioned on said cylindrical member for urging said rings, said annular insulating elements and said driving discs together to establish a frictional driving connection between said rings and the rotatable cylindrical member.

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3. A capstan for advancing a plurality of strands comprising a rotatable cylindrical member, a plurality of annular metal driving discs mounted on said cylindrical member for rotation therewith and for axial movement relative thereto, a plurality of metal rings having strands supporting peripheries disposed between said driving discs, insulating means for movably supporting said rings in insulated and concentric relation to said cylindrical member, insulating elements interposed between said rings and the adjacent driving discs for supporting said rings in spaced and insulated relation to said driving discs, means on said cylindrical member forming a shoulder against which said driving discs, said rings, and said insulating elements may be compressed, and means on said cylindrical member for forcing said rings and insulating elements against each other and said shoulder to establish a friction driving connection between said rings and said annular driving discs.

4. A capstan for advancing a plurality of strands comprising a drum, means for supporting said drum for rotation, a plurality of annular driving discs mounted on said drum for rotation therewith and for axial movement relative thereto, a plurality of metal rings having V-shaped grooves therein for receiving said strands, each of said rings being disposed between a pair of said driving discs, insulating means for removably supporting said rings in insulated and concentric relation to said drum, annular insulating elements interposed between said rings and the adjacent driving discs for supporting said rings in spaced and insulated relation to said driving discs, said plurality of driving discs, rings, and spacers forming a series of annuli capable of being compressed against each other, a first annular pressure member axially adjustable on said drum, means for securing said first pressure member in position on said drum at one end of said series of annuli, a second annular pressure member slidably mounted on said drum at the other end of said series of said annuli, spring means for urging said second pressure member toward said first pressure member to compress said annuli, and means for adjusting said spring means to vary the compression of said annuli.

5. A capstan for advancing a plurality of wires, which comprises a rotatable, cylindrical drum having a plurality

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of axially extending splines provided thereon, a plurality of annular friction driving discs splined on said drum for rotation therewith and for axial movement relative thereto, cylindrical bushings mounted on said drum between adjacent friction driving discs and spaced axially from said discs, a plurality of metal rings having strand-engaging outer peripheries and flat end faces, each of said rings being disposed between a pair of adjacent friction driving discs, insulating means supporting said rings for movement relative to said drum and in spaced and insulated relation to said bushings and said friction driving discs, said insulating means comprising a plurality of complementary pairs of annular elements of L-shaped cross section having flat disc portions and reduced, axially extending, cylindrical shoulder portions positioned with the flat disc portions thereof disposed between and engageable with the side faces of said metal rings and said friction driving discs and with the shoulder portions thereof engageable with the inner periphery of said metal rings and the outer periphery of said bushings for supporting said rings in concentric relation to the drum, each of said pairs of annular elements being spaced axially, said bushings and the annular elements of said insulating means allowing limited axial movement of said friction driving discs relative to each other, a first pressure member positioned on the drum forming a shoulder against which the friction driving discs, the annular insulating elements and the metal rings may be compressed, a second pressure member positioned on the drum for compressing said discs, said insulating elements and said rings together and against the first pressure member to establish a frictional driving connection therebetween so that the metal rings rotate with the drum, and means for adjusting the compressional force exerted by the second pressure member.

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